

MECHANICAL & INDUSTRIAL COLLOQUIUM

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1:00-2:25pm

MEC 224

Modeling and Optimization of Micro-milling Processes for Titanium Alloys

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ABSTRACT

Titanium-based alloys are widely used as a material of choice in various components in aerospace, chemical, pharmaceutical and medical device industries. In fabricating miniaturized products, the micro-milling process possesses several advantages such as ease of use, process flexibility, low set-up cost, variety in work materials and high material removal rates, and is one of the most promising methods for rapid manufacturing of parts with complex three dimensional features in high relative accuracy and precision. However, controlling the micro-end milling process to obtain the desired results is much harder due to the size effect and uncontrollable factors. This work presents experimental investigations and finite element simulations on micro-milling of Ti-6Al-4V alloy with micro-end mills. Micro-milling of Ti-6Al-4V using uncoated and coated tungsten carbide micro-end mills are conducted; surface roughness, burr formation and tool wear are measured. Effects of machining parameters on surface roughness, burr formation, and tool wear are investigated. Finite element modeling is utilized to predict forces, temperatures, and wear rate for micro-tools. Predicted temperature and tool wear contours reveal advantages of coatings. Models have been obtained with statistically based methods are also utilized in multi-objective particle swarm optimization to identify optimum process parameters. The results show that the average surface roughness can be minimized while burr formation is reduced concurrently.

Biography

Professor Tuğrul Özel is Associate Professor in the Department of Industrial & Systems Engineering at Rutgers University. He received his Ph.D. from Mechanical Engineering from Ohio State University in 1998. He was a summer faculty fellow at NASA Glenn Research Center in 1999. He teaches courses on manufacturing processes, automation, production systems and simulation modeling. His research program focuses on computational modeling and optimization of manufacturing processes at multi-scale; high speed machining, micro-milling, laser micro-machining, and additive laser sintering processes. Professor Özel has published over 80 articles in leading manufacturing journals & conferences, and co-edited two books (Intelligent Machining: Modeling and Optimization of the Machining Processes and Systems, Wiley 2009, and "Micro-Manufacturing: Design and Manufacturing of Micro-Products, Wiley 2011). He is the Founding Editor and Editor-in-Chief of the International Journal of Mechatronics and Manufacturing Systems as well as member on the editorial boards of several international journals. He has been member of scientific or program committee on over 20 international conferences. His research has been well funded by National Science Foundation, NASA and industry. He is senior member of SME, ASME, and Associate Member of International Production Academy, CIRP.

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